Specification

Circuit Comprising an Integrated Switching Circuit and a Voltage Regulating Circuit

This invention relates to a circuit comprising an integrated switching circuit and a voltage regulating circuit, which furnishes a regulated voltage for the operation of the circuit.

Circuits are constructed from electrical and/or electronic components as well as integrated circuits on an insulating board. The connections between the components and circuits are made via conductor paths. The energy necessary for the operation of the circuit is fed in the form of a supply voltage. For proper functioning of the circuit, the value of the supply voltage must lie in a certain range. If an available voltage is unsuitable as a supply voltage because of excessively large voltage fluctuations, a constant supply voltage can be obtained with a voltage regulating circuit.

Voltage regulating circuits are discrete components that, from an input voltage that can lie in a certain range, deliver a nearly constant output voltage largely independently of the load on the output of the voltage regulating circuit. The voltage regulating circuit generates, for example from the available fluctuating voltage, the constant supply voltage that is required for the proper operation of the circuit. The voltage regulating circuit is mounted on the board along with the other discrete components and the integrated circuits.

An example of such a circuit is an ISDN adapter for a personal computer with a universal interface (USB – Universal Serial Bus – interface) interface),

which can be obtained under the designation "Siemens I-Serve USB." The adapter includes a board, on which a voltage regulating circuit is present along with some integrated circuits and discrete components, some of which are surface-mounted devices (SMD). The voltage regulating circuit in turn includes a plurality of components and circuits and forms its own functional unit. It is connected to the other components via conductor paths. Via the serial bus, for example, the voltage regulating circuit includes the voltage to be regulated. The population of the board with the components of the voltage regulating circuit requires additional time. A larger area must be provided on the board in order to accommodate the voltage regulating circuit. This gives rise to additional costs.

The goal of the present invention is to identify a circuit, comprising an integrated switching circuit and a voltage regulating circuit, which takes up less area than known circuits of the kind stated and requires less effort in the population of boards.

This goal is achieved by a circuit having the features of Claim 1.

The invention has the advantage that the circuit can be mounted on a smaller area. During assembly, for example on a board, fewer components have to be attached and contacted. The effort in designing the topographies is reduced.

In one embodiment, there is an internal connection between the switching circuit and the voltage regulating circuit. The internal connection is also integrated on the substrate material, as are the two circuits. Advantageously, the voltage regulating circuit is additionally connected to a contact that is accessible outside the circuit. In this way, the supply voltage can be fed both to the

switching circuit and also to further circuits independent of the circuit.

In a further embodiment, there is no internal connection between the voltage regulating circuit and the switching circuit. The supply voltage is fed to the switching circuit from outside. It does not necessarily have to originate from the voltage regulating circuit itself but can also be furnished from an external voltage source. Preferably there is a switch for this purpose, with which the selection is made between the voltage regulating circuit and the external voltage source.

Further advantageous embodiments are characterized in the dependent claims.

In what follows, the invention is explained in greater detail on the basis of exemplary embodiments illustrated in the figures. Corresponding elements are identified by the same reference numerals. The figures show:

Figure 1: a first embodiment with an internal connection between the integrated switching circuit and the voltage regulating circuit

Figure 2: a second embodiment with an internal connection

Figure 3: a first embodiment with an external connection between the integrated switching circuit and the voltage regulating circuit

Figure 4: a second embodiment with an external connection.

According to one embodiment as shown in Figure 1, the circuit exhibits an integrated switching circuit 1 and a voltage regulating circuit 2. A data bus 3 connects the circuit to a main device 4. Main device 4 is, for example, a computer (PC) that is upgraded with a function that is implemented by switching circuit 1.

Data bus 3 supplies the circuit with a supply voltage V having a first potential VDD and a second potential VSS as well as for the exchange of data D-, D+ between switching circuit 1 and main device 4.

In order to obtain a constant supply voltage, the supply voltage V delivered via data bus 3 from main device 4 is fed to voltage regulating circuit 2. The voltage regulating circuit generates a regulated supply voltage VG, which is largely constant even in case of fluctuations of the supply voltage VDD, VSS.

Regulation of the supply voltage is necessary, as a rule, if the supply voltage V delivered from main device 4 is subject to fluctuations that are too large for the proper operation of the circuit.

Both switching circuit 1 and voltage regulating circuit 2 are integrated on a substrate material. Suitable as the substrate material is, for example, a semiconductor substrate, on which all components of switching circuit 1 and of voltage regulating circuit 2 are implemented and connected into the desired circuits in a unified technological process. The components can also be mounted on a glass or ceramic substrate. Circuits 1 and 2 form a unit and are mounted, for example, in a package.

There can be an electrical connection between switching circuit 1 and voltage regulator 2. Circuits 1 and 2 can, however, also be electrically isolated from each other.

Any contacts and outputs of switching circuit 1 that may be present are not shown in Figure 1.

In the exemplary embodiment according to Figure 1, there is an internal connection 5 between voltage regulating circuit 2 and switching circuit 1. The regulated supply voltage VG of voltage regulating circuit 2 is furnished to switching circuit 1 via this internal connection 5 as the

voltage necessary for the operation of switching circuit 1. Internal connection 5 thus makes an electrical connection between circuits 1 and 2.

Internal connection 5 is again present in the exemplary embodiment of Figure 2. This exemplary embodiment has all the elements of the exemplary embodiment of Figure 1. In addition, voltage regulator 2 in this case includes a voltage contact 6 at which the regulated supply voltage VG can be taken off. Voltage contact 6 is led out of the substrate material of voltage regulator 2. Voltage contact 6 is accessible outside the circuit even if the circuit is mounted in a package.

An additional device 7, for the operation of which a regulated supply voltage VG is likewise required, can be connected via voltage contact 6. In this case, voltage regulating circuit 2 supplies both switching circuit 1 and also additional device 7 with the regulated supply voltage VG.

Additional device 7 is not integrated on the substrate material. It is a free-standing device that can be operated without the circuit.

In the exemplary embodiment of Figure 3, there is no internal connection between voltage regulating circuit 2 and switching circuit 1. Insulation 8 electrically isolates switching circuit 1 from voltage regulating circuit 2. The regulated supply voltage VG is not fed to switching circuit 1 within the circuit. Switching circuit 1 is supplied via an external linking line 9, which is connected to voltage contact 6. Because of insulation 8, the regulated supply voltage of voltage regulating circuit 2 can be taken off only via the voltage contact. The voltage contact can be built up from a plurality of contacts. External linking line 9

is connected to supply contacts 10 as well as to voltage contact 6. Supply contacts 10 are electrically connected to switching circuit 1. Switching circuit 1 is supplied with the voltage necessary for operation via the supply contacts.

Insulation 8 must be such that the regulated supply voltage VG does not affect switching circuit 1 if no linking line 9 is connected to voltage contact 6. Exchange of charge carriers between switching circuit 1 and voltage regulating circuit 2 can nevertheless be possible.

Along with external linking line 9, additional device 7 can also be connected to voltage contact 6, as it is in the exemplary embodiment of Figure 2. Voltage regulating circuit 2 then supplies both additional device 7 and also, via external linking line 9 and supply contacts 10, switching circuit 1 with the regulated supply voltage VG. The supply voltage VDD, VSS is delivered from main device 4 to voltage regulating circuit 2 via data bus 3. Data exchange between main device 4 and switching circuit 1 also takes place via data bus 3.

A further exemplary embodiment of a circuit, in which switching circuit 1 is electrically isolated from voltage regulating circuit 2, is shown in Figure 4. As in the exemplary embodiment of Figure 3, circuits 1 and 2 are isolated by insulation 8. Here, voltage contact 6 is connected to external linking line 9 not directly but via a first switch 11. If first switch 11 is closed, a connection is made between voltage contact 6 and supply contacts 10. Again, there can be additional device 7, which is connected to external linking

line 9 in such a way that it is supplied with the regulated supply voltage VG when first switch 11 is closed.

External linking line 9 is connected to an external voltage source 13 via a second switch 12. The two switches 11, 12 are designed in such a way that only one of the switches can be closed at any time. If first switch 11 is opened, second switch 12 is closed. If second switch 12 is opened, first switch 11 is closed. This switching condition can be imposed, for example, by an appropriate mechanical device or a suitable electronic control.

In the exemplary embodiment of Figure 4, switching circuit 1 and additional device 7, if present, can be supplied from voltage regulating circuit 2 or external voltage source 13, as selected. External voltage source 13 likewise generates the regulated supply voltage VG. It is not integrated on the substrate material and is connected to external linking line 9, for example via a connecting line.

The supply via external voltage source 13 can be present, for example, if the power furnished via data bus 3 is not sufficient for the operation of switching circuit 1. Switching circuit 1 can be operated even in case of a defective voltage regulating circuit 2.

The circuit can be embodied, in particular, with a switching circuit for telecommunications purposes, for example ISDN (Integrated Services Digital Network) adapter.